COT 5405: Programming Assignment 2

Description

This program simulates the addition and removal of nodes from a random graph process. A node is added to the graph with a probability of *p*. The node on the other end of the edge of the new node is selected based on a linear preferential attachment rule which is:

$$\mathbb{P}_{t+1}[u] = \frac{d_t(u)}{2m_t}$$

Where:

- $d_t(u)$ is the degree of a given node in graph G_t
- m_t is the total number of edges in graph G_t

A node is removed from a graph with a probability of *q* (where *q = 1-p*). The node selected to delete is chosen based on a probability distribution that favors small degree nodes. When a node is deleted, all edges associated with that node will be removed as well. The probability is determined based on the following formula:

$$\mathbb{P}_{t+1}[u] = \frac{2m_t - d_t(u)}{2m_t(n_t - 1)}$$

Where:

- $d_t(u)$ is the degree of a given node in graph G_t
- n_t is the total number of nodes in graph G_t
- m_t is the total number of edges in graph G_t

In this script, the behavior of G_t is analyzed with p = 0.6. 0.75, 0.8 and 0.9. The output will display the following graphs (using matplotlib):

- Number of Nodes vs. Time
- Number of Edges vs. Time
- Degree Distribution of Nodes

Requirements

This script is written for Python 3 and requires the following modules in order to run properly:

- matplotlib
- numpy
- networkx

- tkinter

To install in Windows:

```
pip3 install --upgrade matplotlib numpy networkx
```

To install in macOS:

```
sudo -H pip3 install --upgrade matplotlib numpy networkx
```

To install in Ubuntu (debian linux):

```
sudo -H pip3 install --upgrade matplotlib numpy networkx
sudo apt-get install python3-tk
```

Usage

To run the simulation type the following command into the command prompt:

In Windows:

```
py -3 generate_random_graph_final.py
```

In macOS and Ubuntu (debian linux):

```
python3 generate_random_graph_final.py
```

Output will look like the following:

Figure 1:

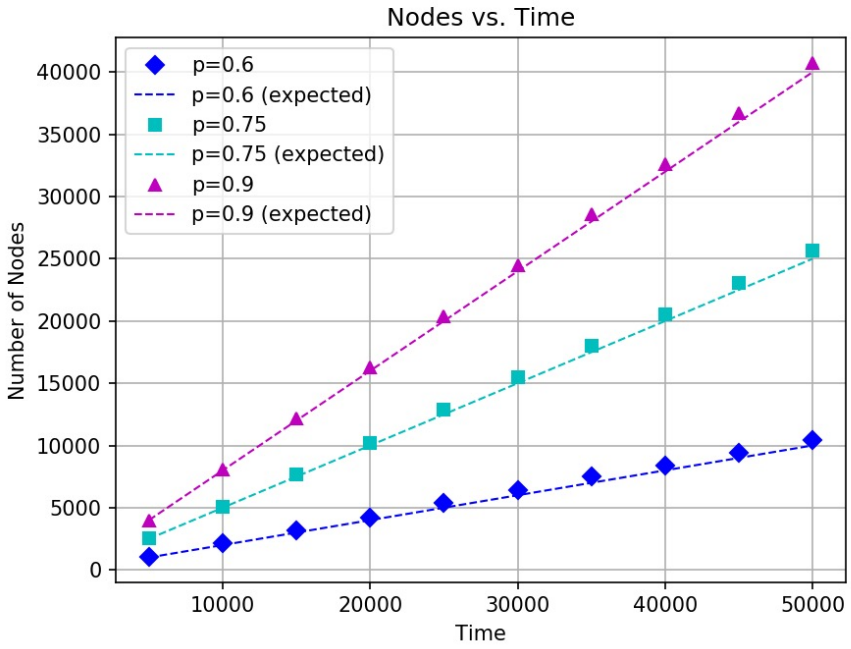

Figure 2:

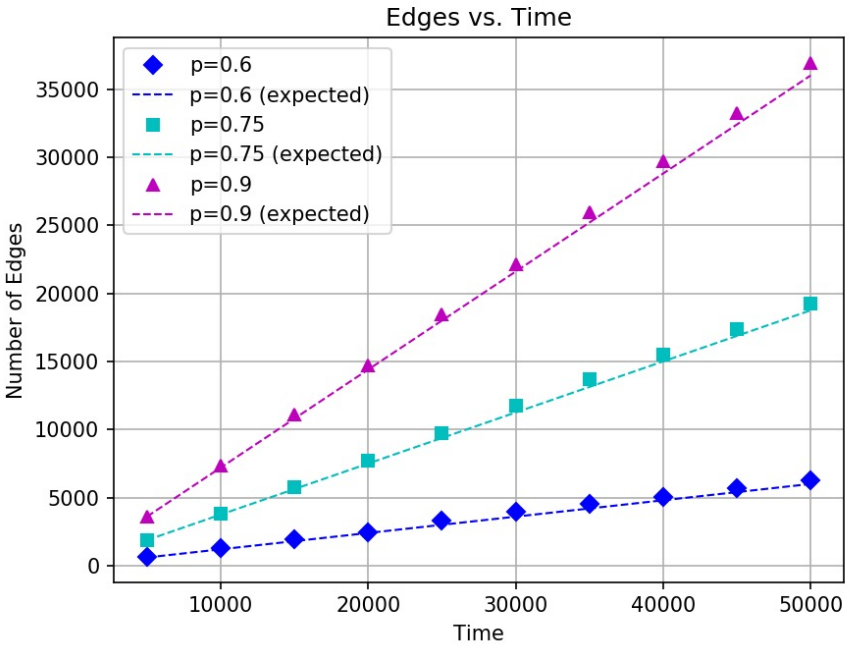

Figure 3: